SAMPLING AND ANALYSIS PLAN
FOR THE SOUTHERN CONCRETE PAD AREA
ECC SUPERFUND SITE
ZIONSVILLE, INDIANA

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I. INTRODUCTION

A. Background

This Sampling and Analysis Plan (SAP) provides a methodology for: (1) generating a random data set to be used to evaluate the Resource Conservation and Recovery Act (RCRA) clean closure of the former Southern Concrete Pad Area (SCPA) of the Environmental Conservation and Chemical Corporation Superfund Site (the "ECC Site"); (2) calculating the 95% upper confidence limit of the mean (UCL) of the newly collected data; and (3) comparing the 95% UCL values to calculated Indiana Risk Integrated System of Closure[1] (RISC) default and calculated nondefault standards. The RCRA clean closure requirements for the SCPA are set forth in Section 2.1.1 and Appendix F of *Revised Exhibit A*[2]. Paragraph 5.3 of Appendix F specifies that the "then current IDEM RCRA clean closure criteria will be established for this site using the then current IDEM RCRA clean closure regulations and Guidance." The "current IDEM RCRA clean closure regulations and guidance" is IDEM's RISC. RISC provides both a risk-based default approach applicable to all sites and a flexible approach, which includes site-specific data and/or alternate models for site closure, for all IDEM remediation programs (including RCRA). IDEM currently refers to "clean closure" as "closure by removal or decontamination."

B. SCPA Excavation and Confirmatory Sampling

A location map for the ECC Site is provided as Figure 1 and an ECC Site SCPA base map is provided as Figure 2. The excavation of the soils underlying the ECC Site SCPA took place during the summer of 1998. The minimum limits of excavation were the lateral extent of the concrete pad and a minimum depth of nine feet. The maximum limits of excavation were defined in Revised Exhibit A.[3] The actual limits of excavation

[1] RISC is described in the User's Guide, dated February 15, 2001 and the Technical Guide, dated February 15, 2001

[2] Revised Exhibit A, May 7, 1997, Revision 2.

[3] The maximum safe depth was defined based on the recommendation of an independent Indiana-registered engineer specializing in geotechnical engineering (p. 4 of Revised Exhibit A). The maximum lateral extent of the excavation was defined in Appendix F of Revised Exhibit A as the top of the bank of Unnamed Ditch to the east, the road to Northside Landfill to the south, the western fence bordering the support zone to the west, and the edge of the concrete pad to the north.

were determined by U.S. EPA through visual inspection or by field screening up to the maximum safe depth.[4]

Post-excavation confirmatory soil samples (Confirmation Samples) were collected from the bottom and sidewalls of the open excavation in June and July of 1998 in accordance with the procedures specified in Appendix F to Revised Exhibit A. The samples were collected by CH2M Hill personnel under the direction of the U.S. EPA. The Confirmation Samples were analyzed for volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) using U.S. EPA Methods 8260A and 8270B, respectively.

An evaluation of the U.S. EPA confirmatory sampling data pursuant to RISC guidance for clean closure was conducted by ENVIRON and presented in a May 2001 report entitled *Technical Memorandum, Closure by Removal or Decontamination of the Southern Concrete Pad Area* (the "Technical Memorandum"). In its June 29, 2001 comment letter, IDEM concluded that the U.S. EPA-directed closure samples were collected based on judgmental criteria, rather than as randomly selected samples as required by RISC for clean closure determination. In addition, IDEM expressed concern that the samples were "old", i.e. had been collected over three years ago. Therefore, the objective of this SAP is to generate a random data set for clean closure evaluation pursuant to RISC guidelines, which will satisfy both of IDEM's principal concerns.

[4] Revised Exhibit A, May 7, 1997, Revision 2, p. 2.

II. SCOPE OF WORK

The scope of the proposed sampling program follows the procedures outlined in Section 7.9 of the RISC Technical Guide (*Nondefault Characterization and Closure Sampling*). The development of the sampling program is broken down into six components:

- Presampling Activities;
- Horizontal Stratification;
- Sample Size Determination;
- Selecting Appropriate Sample Locations;
- Sample Collection and Analysis; and
- Quality Assessment.

A. Data Collection and Analysis

1. Presampling Activities

In RISC, the Presampling Activities include: (1) review of existing site information; (2) selecting an approach to sampling; (3) determining the boundaries of the waste site; and (4) obtaining or preparing a detailed map of the waste site.

As discussed in the May 2001 Technical Memorandum, a large amount of physical and chemical characterization data has been collected in the SCPA. These data have been reviewed in preparation of this plan and are included herein by reference.

The approach to clean closure sampling described below involves the collection and analysis of randomly located soil and subsurface water samples within the upper till unit in areas adjacent to and beneath the footprint of the SCPA excavation.

The horizontal boundaries for the sampling program, herein referred to as the "investigative area", reflect the maximum lateral extent prescribed in Appendix F of

Revised Exhibit A for the SCPA excavation (see Footnote 3). These boundaries are depicted on a detailed map of the site (Figure 3) and are defined as follows:

Northern Limit: The northern edge of the former SCPA excavation will define the northern limit of the investigative area. The northern extent of the SCPA was terminated approximately 18 feet north of the northern edge of the SCP, where the excavation encroached upon the southern limit of the RCRA cap and liner system.

Western Limit: The western fence bordering the support zone will define the western boundary of the investigative area.

Southern Limit: The northern edge of the road to Northside Landfill will define the southern boundary of the investigative area.

Eastern Limit: The top of the bank of Unnamed Ditch or the eastern site fenceline, which generally corresponds with the top of the bank, will define the eastern boundary of the investigative area.

The interface between the upper till unit and the lower sand and gravel unit is considered the vertical boundary for closure sampling. The thickness of the upper till unit in the SCPA ranges from approximately 14 feet to 27 feet.

2. Horizontal Stratification

The upper till unit consists of a low permeability till that ranges from clay to silty clay with some sand. The upper till unit creates a confined condition for subsurface water in the underlying sand and gravel aquifer. Using the concept of "vertical strata" described in Section 7.9.2 of the RISC Technical Guide, the investigative area can be divided into two vertical strata: (1) the upper unsaturated portion of the till; and (2) the lower saturated portion of the till. Since these strata differ in their degree of saturation, their capacity to transmit contaminants through

advection, diffusion, or other mechanisms, and the potentially impacted media, they are treated separately in the process used to select random sample depths.

Soil samples will be collected from the upper unsaturated portion of the till. For the lower saturated portion of the till, an attempt will first be made to collect a subsurface water sample. However, since either soil or subsurface water data can be used to calculate nondefault clean closure standards, a soil sample will be collected from the pre-selected sample depth for any borings that do not yield sufficient subsurface water for sampling. With the following exceptions, both of the aforementioned vertical strata will be sampled throughout the investigative area:

- The till beneath the base of the SCPA excavation is within the lower saturated till vertical stratum and will be sampled as such.

- Randomly selected samples collected in the area between the SCPA excavation and the southern investigative area boundary will be limited to the unsaturated till stratum.[5]

The aerial extent of the vertical strata is shown on Figure 3.

3. Sample Size Determination

In accordance with the methodology described in Section 7.9.3.2 of the RISC Technical Guide, the number of samples required to make a closure decision for the SCPA (the "sample size") was determined by placing an orthogonal grid over the investigative area (aligned with the existing site coordinate system) to establish grid points (nodes of the grid lines). The grid spacing should represent the shortest interval between two points that would provide reasonably independent samples. The appropriate grid spacing interval was determined by plotting the experimental semi-variogram of the confirmation sample data on a North/South axis (Appendix

[5] Subsurface water in this area is being investigated as part of a separate effort and is not included in the SPCA closure process.

A).[6,7] The experimental semi-variogram graph shows the relationship (or difference) between sample values versus the distance between their locations. A curve (Gaussian Model) was fitted to the data (i.e. to obtain the best fit according to the Modified Cressie Parameter) to determine the point at which there is no relationship with distance. The absence of a relationship is demonstrated by a flattening out of the curve (the "sill"). While the distance to the sill or range of influence was determined to be 49 feet, a conservative grid spacing of 10 feet was selected based on RISC guidance.

The sample size, which in this case represents the number of randomly located soil borings, was determined using the calculation $\sqrt[3]{n}$, where n is the number of grid points within the investigative area. Figure 3 shows the sampling grid. There are 351 grid points for the unsaturated stratum; therefore the sample size was determined to be 8 samples ($\sqrt[3]{351}$ grid points). Section 7.9.3.2 of the RISC Technical Guide states: *The minimum sample size...for source areas greater than or equal to ½ acre will never be less than 14.* Therefore, the sample size was set at 14 for the unsaturated stratum.

There are 642 grid points for the saturated stratum; therefore the sample size was determined to be 9 samples ($\sqrt[3]{642}$ grid points). Again, since the minimum sample size for source areas greater than or equal to ½ acre will never be less than 14, the sample size was set at 14 for the saturated stratum.

4. Selecting Appropriate Sample Locations

Use of nondefault procedures for achieving RCRA clean closure requires the selection of random sample locations. Random selection of sample points requires that each point be selected independent of the location of all other sample points. With random sampling, no pattern is expected in the distribution of the sampling points.

6 Clark, I. And Harper, W.V (2000) *Practical Geostatistics 2000*, Ecosse North Americal Llc, Columbus Ohio, USA.
7 Kitanidis, P.K. (1999) Introduction to Geostatistics Applications in Hydrogeology, Cambridge University Press, New York, New York.

The grid sampling procedure described in Section 7.9.4.4 of the RISC Technical Guide was used to select random locations for soil borings. Figure 4 shows the grid points for the unsaturated till stratum and Figure 5 shows the grid points for the saturated till stratum. The grid points for each stratum were numbered sequentially and were placed in a random order using the random number generator contained in the Microsoft Excel program. Using the same Microsoft Excel program, 14 soil boring locations for each stratum were randomly chosen from the list of grid points. The randomly selected soil boring locations for the unsaturated stratum are shown on Figure 4 and the randomly selected soil boring locations for the saturated stratum are shown on Figure 5.

To determine the random sampling depth for each soil boring location, the following procedure was used:

- Using logs for previous soil borings, monitoring wells or other information sources (e.g., final SCPA excavation depth), the thickness of the target vertical stratum was estimated. For the saturated zone, the stratum extends between the till water interface (or the bottom of the SCPA excavation) and the base of the upper till unit. For the unsaturated zone, the stratum extends from the ground surface to the till water interface.

- At each randomly selected soil boring location, a one-foot sample interval was determined using a random number generator. The random number generator was used to select a percentage between 1% and 100%. This percent value was then multiplied by the thickness of the target vertical stratum and rounded to the nearest one foot to obtain the sample depth. The estimated thickness of the vertical stratum and the randomly selected sample depths for each soil boring are presented on Figure 4.

If during completion of the soil borings it is determined that a pre-selected sample depth does not lie within the appropriate vertical stratum (e.g., the sample

falls within the backfill for the SCPA excavation or within the lower sand and gravel unit), the sample depth will be adjusted, such that it is located in the nearest one-foot interval of the appropriate vertical stratum. Since the identification of sample depths that do not fall within the appropriate vertical stratum would be expected to occur on a random basis as a result of slightly overestimating or underestimating the thickness of the stratum, the randomness of the sample depth selection process is expected to be preserved.

In addition, the volatile organic fraction of any soil samples that are randomly assigned a depth of one foot or less below ground surface will be collected from a depth interval of 1.0 to 2.0 feet below ground surface.

5. Sample Collection and Analysis

Using the existing surveyed coordinate system at the ECC site, each of the randomly selected soil boring locations shown on Figure 4 will be located by a surveyor. Based on ENVIRON's understanding of the physical conditions at the site, it is not anticipated that any of the soil boring locations will require relocation based on site access limitations.

All of the soil borings will be completed using a direct-push drilling/sampling apparatus (e.g., Geoprobe®). Two-inch diameter soil cores will be collected continuously using four-foot long core barrels with dedicated polyethylene sleeves. For the unsaturated till stratum, a soil sample will be collected from the pre-selected one-foot depth interval. For the saturated till stratum, an attempt will be made to collect a subsurface water sample from the pre-selected one foot sample interval. The water sample will be collected using a one-foot long retractable screen that is exposed to the surrounding formation by pulling up on the drilling rods. If sufficient water enters the screen within a period of approximately 30 minutes, a water sample will be collected from the retractable screen using a peristaltic pump and dedicated sample tubing. If the amount of water that enters the screen does not allow for the collection of a water sample, a soil sample will be collected from the pre-selected one-foot sample interval.

The soil samples will be analyzed for VOCs using USEPA's *Test Methods for Evaluating Solid Waste-Physical/Chemical Methods, SW-846* method 8260B as well as IDEM's IN-5035M field preservation procedure. The soil samples will also be analyzed for SVOCs using SW-846 method 8270B. The subsurface water samples will be analyzed for VOCs by USEPA method 8260B and for SVOCs by USEPA method 8270B

All sampling, analysis, and quality assurance/quality control procedures will be conducted in accordance with applicable procedures contained in the ECC Site Quality Assurance Project Plan (QAPP) dated September 1996 prepared by Radian.[8] Field blank samples will be collected at a minimum rate of 1 per day per medium and analyzed for VOCs and SVOCs. One trip blank will be maintained per bottle shipment and analyzed for VOCs. Field duplicate samples will be collected at a minimum rate of 1 for every 10 samples and analyzed for VOCs and SVOCs. Laboratory matrix spike and matrix spike duplicate samples will be analyzed in accordance with ECC Site QAPP requirements.

6. Quality Assessment

All data quality assessment will be as specified in Section 7.9.6 of the RISC Technical Guide and the ECC Site QAPP.

B. Data Evaluation and Clean Closure Determination

The Trustees propose to calculate the 95% UCL for use in the SPCA clean closure evaluation using the EPA-recommended Bootstrap Method. The Bootstrap Method is one of the methods recommended by the U.S. EPA for the calculation of the upper confidence level for the mean of a lognormal distribution (USEPA, Technology Support Center Issue, *The Lognormal Distribution in Environmental Applications*, December 1997) and is viewed as the most accurate of the recommended alternatives.

Calculating the reasonable maximum exposure (RME) for a particular COC using the Bootstrap Method involves four primary steps. First, the data for each COC family are tested for normality by calculating the probability that the log-transformed data are

[8] As modified by subsequent revisions.

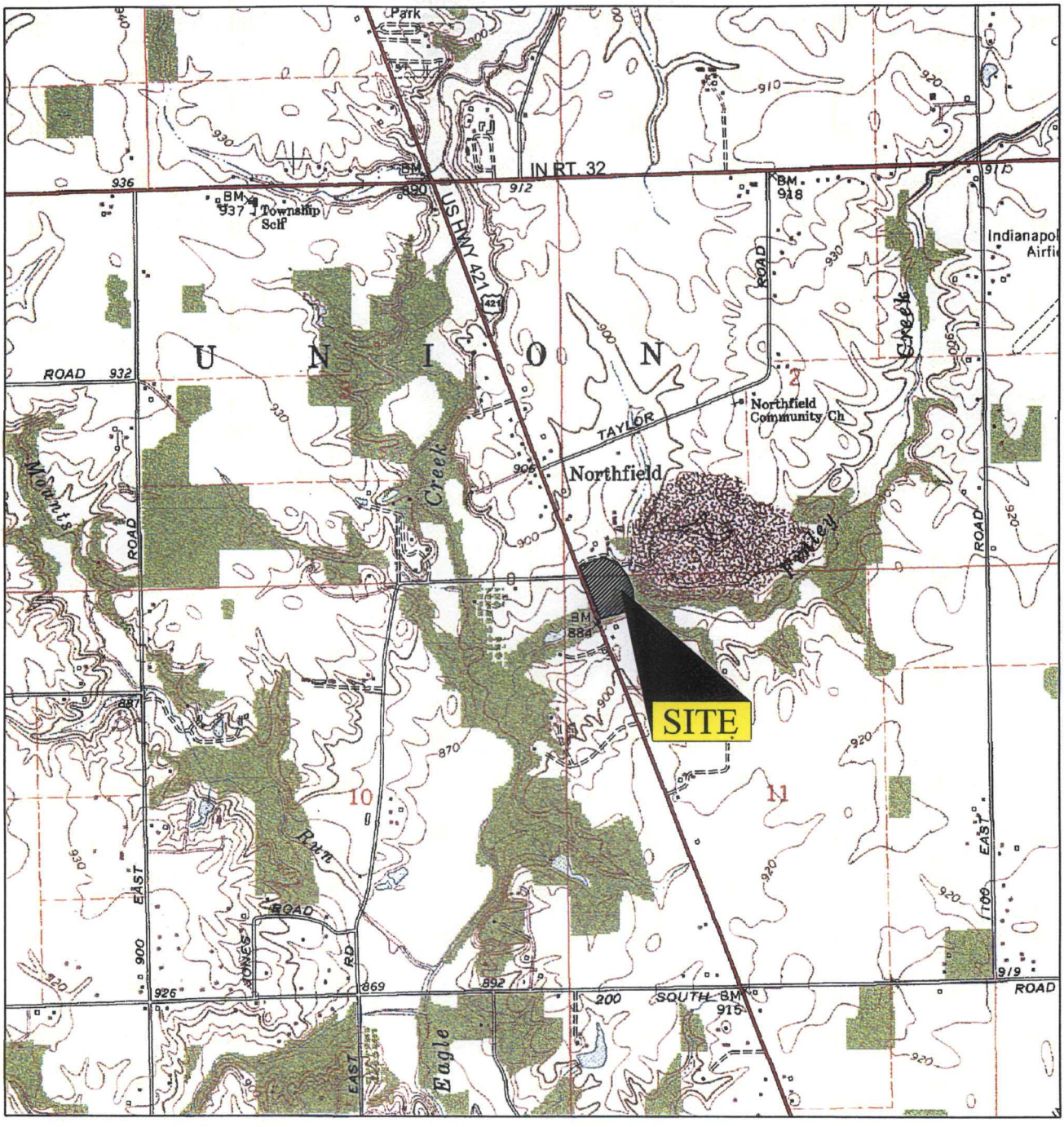
normally distributed. If the probability is greater than 5 percent, then the sample data are log-transformed. Second, 1,000 trials of sample size *n* (equal to the original sample size) are created by drawing (with replacement) *n* random values from the original sample population (with lognormal transformation). Third, for each trial, the mean and variance are calculated. The 95% UCL of the average of the bootstrap transformed means is calculated using the actual frequency distribution of the 1,000 trials. This 95% UCL is then used to represent the RME for that COC.

The 95% UCL for all detected constituents will be compared to RISC default criteria. For constituents that exceed the default criteria, the 95% UCL will be compared to calculated RISC nondefault criteria.

C. Reporting and Schedule

The results of the SAP activities will be submitted to the U.S. EPA and IDEM in a revised Technical Memorandum. It is anticipated that the field sampling activities will begin within 2 to 3 weeks of the approval of this SAP. The fieldwork is expected to take 1 to 2 weeks to complete. Assuming the data are received approximately 4 weeks following the completion of the fieldwork, a revised Technical Memorandum will be submitted to U.S. EPA and IDEM within approximately 12 weeks of approval of this SAP.

FIGURES



SCALE 1: 24000

1 1/2 0 1 MILE

2000 0 2000 4000 6000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 40 FEET

DOTTED LINES REPRESENT 10-FOOT CONTOURS

NATIONAL GEODETIC VERTICAL DATUM OF 1929

SOURCE: U.S.G.S. 7.5 minute series (topographic)
Indiana - Boone Co. 1969

N

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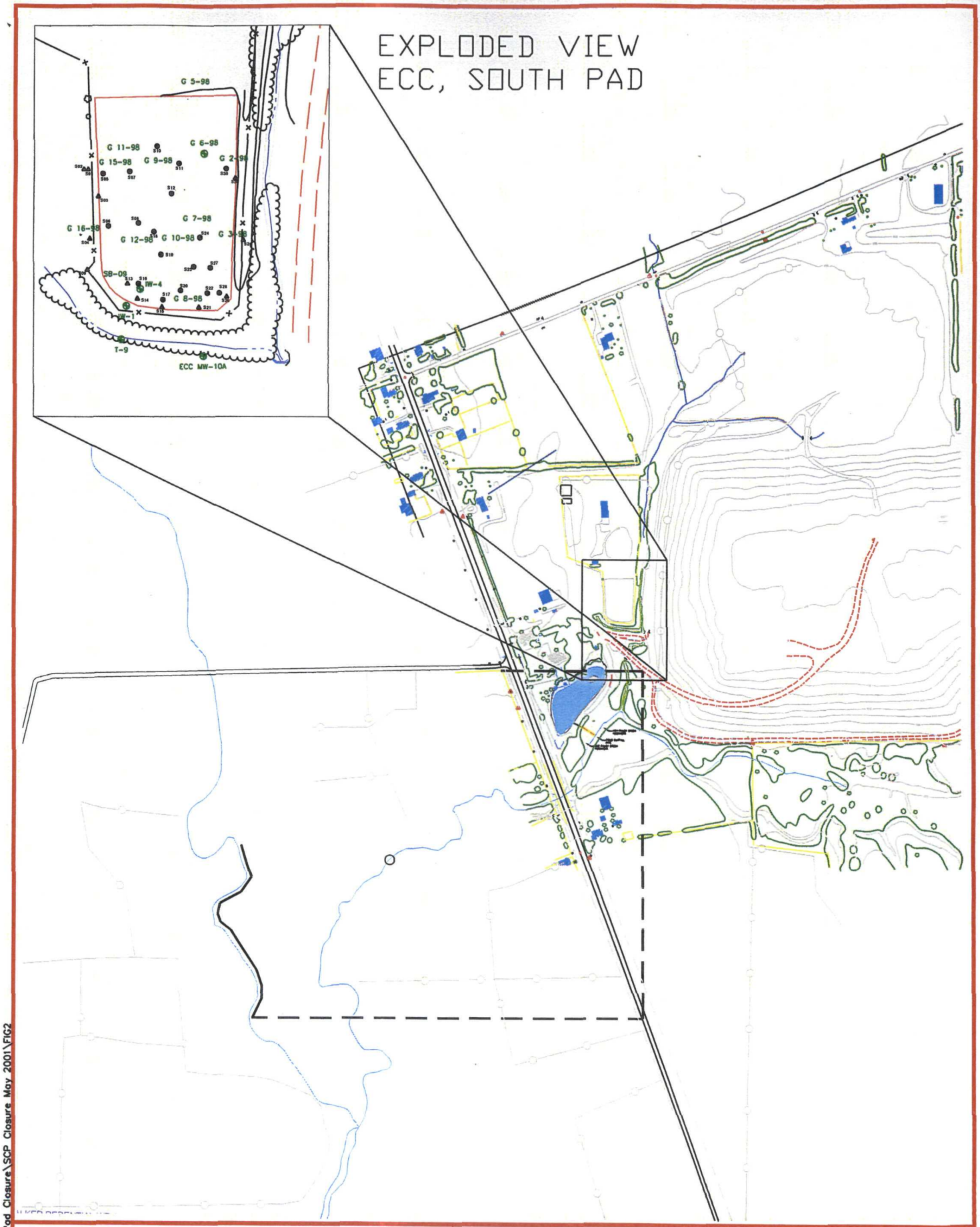
General Location Map
ECC
Zionsville, Indiana

Figure 1

Drafter: BJM | Date: 8/10/00 | Contract Number: 216585 | Approved: | Revised:

: \Client Project Files\ECC\South Pod Closure\SCP Closure May 2001\Fig1



CPF\ECC\South_Pad_Closure\SCP_Closure_May_2001\FIG2

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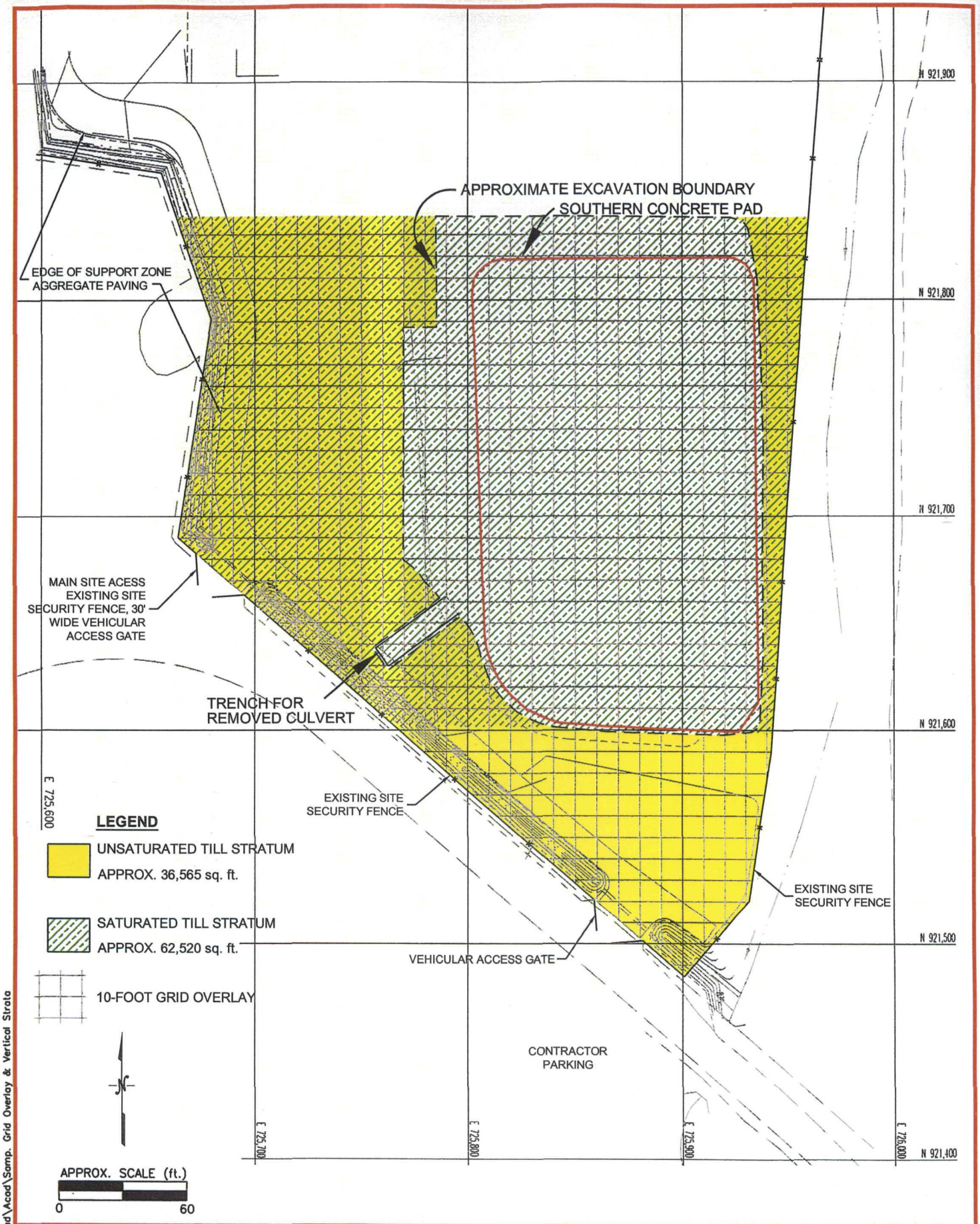
SOUTHERN CONCRETE PAD AREA
ECC SITE
ZIONSVILLE, IN

Figure
2

Drafter:	GTH	Date:	08/10/00	Contract Number:	21-6585C	Approved:	Revised:



CPF\ECC\South Pad\Acad\Samp. Grid Overlay & Vertical Strata

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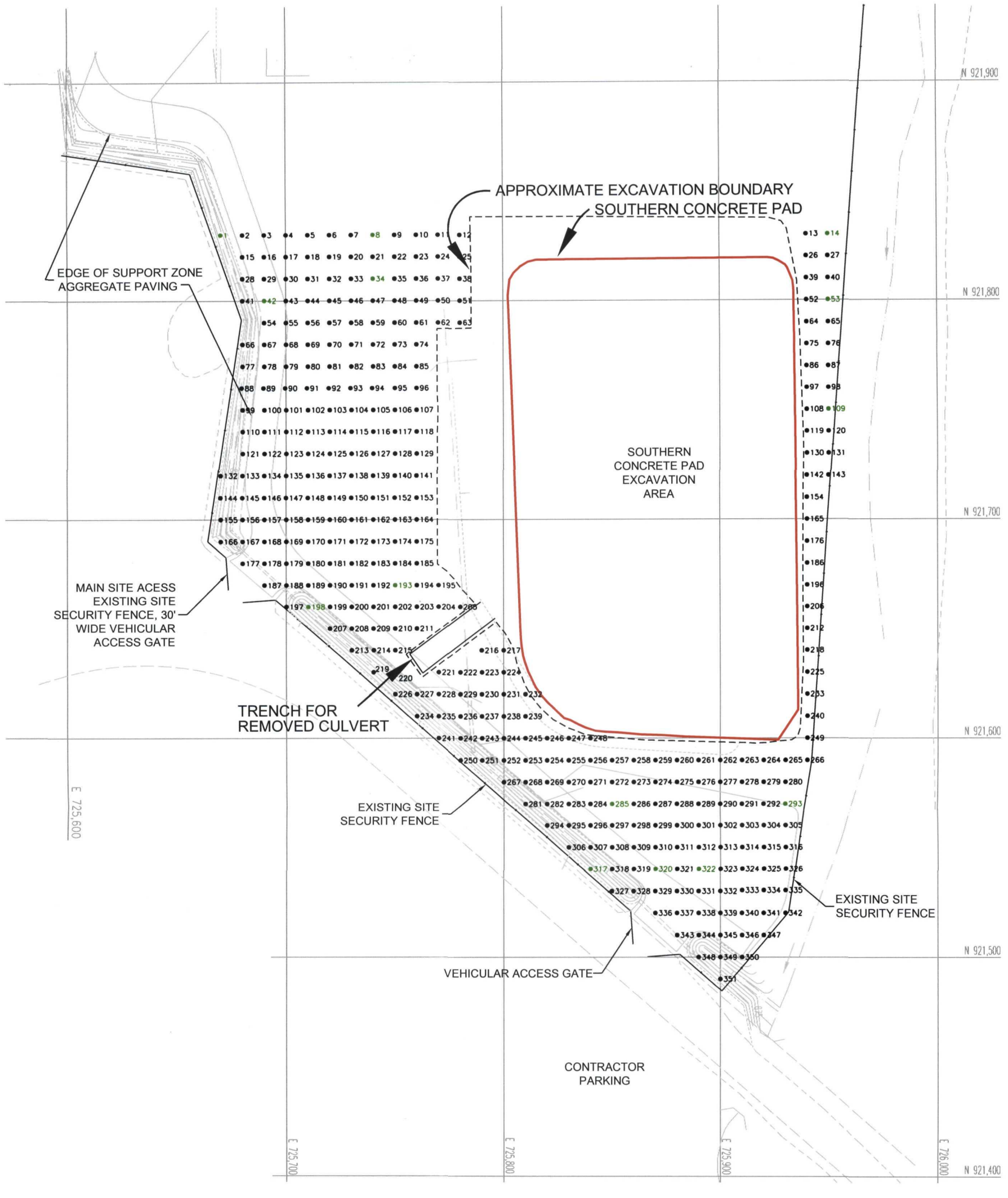
Sampling Grid Overlay and Vertical Strata
Southern Concrete Pad Area
Enviro-Chem Superfund Site

Figure
3

Drafter: APR | Date: 10/25/01 | Contract Number: 21-6585C | Approved: REH | Revised:



Grid Sample Location1	Depth to Till Water (ft bgs)2	Sample Depth (unsaturated stratum)3
1	8.5	4
8	8.5	6
14	9.5	4
34	8.5	4
42	8.0	6
53	9.5	5
109	9	1
193	5.5	3
198	5.5	1
285	3.5	3
293	5.0	1
317	3.5	0
320	3.5	2
322	4.0	4

KEY

- **Grid Point (Grid Interval = 10ft.)**
- **Randomly Selected Sampling Location**

Notes:
1. Represent proposed soil boring locations
2. Feet bellow ground surface
3. Depth represents base of one-foot sample interval

25 12.5 0 25 50

SCALE: 1" = 25'

CPF/ECC/South Pad/Acad/Proposed Sample Locations & Depths for Unsaturated Stratum

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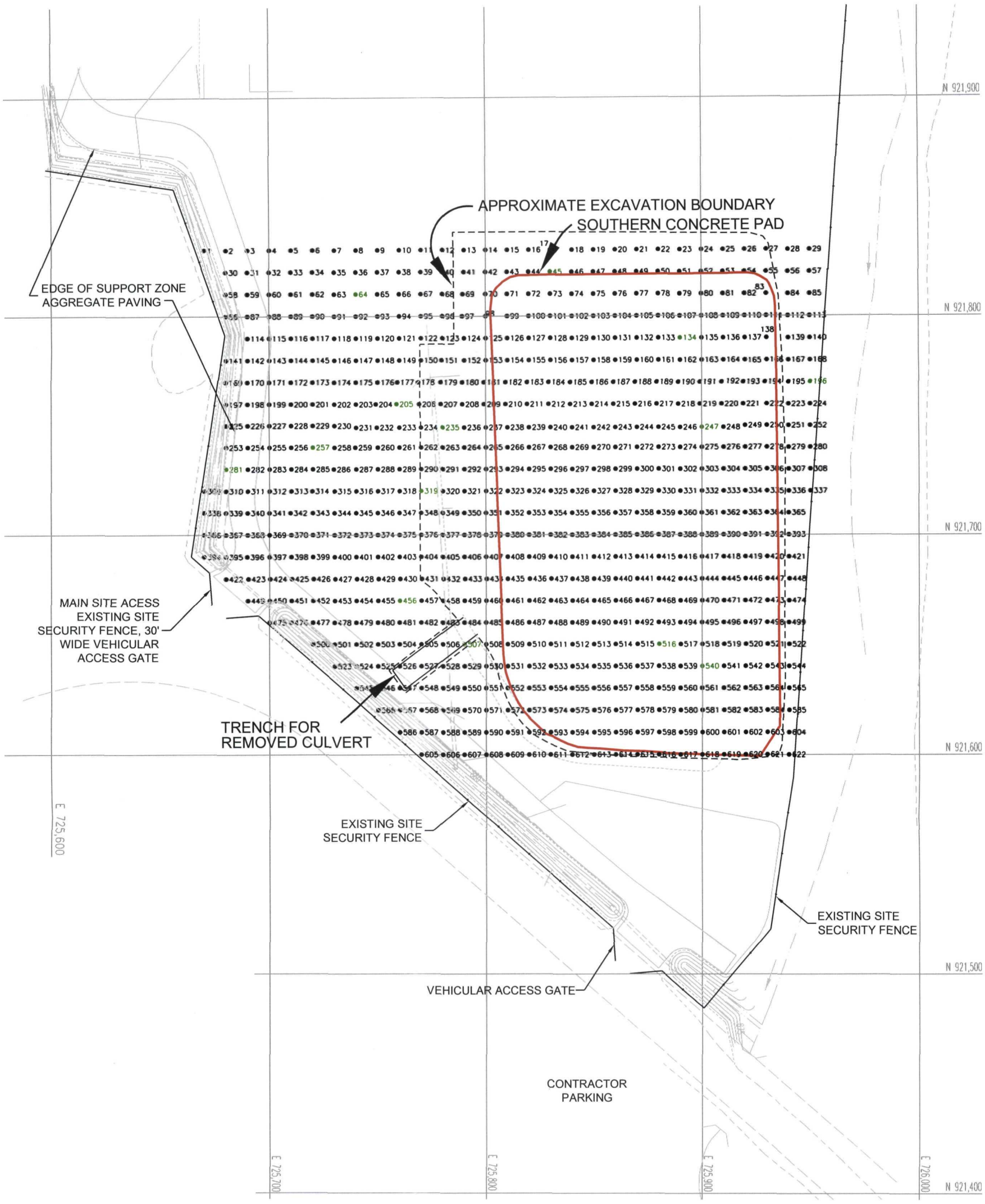
Proposed Sample Locations and Depths for Unsaturated Stratum
Southern Concrete Pad Area
ECC Site
Zionsville, IN

Figure 4

Drafter: APR | Date: 12/12/01 | Contract Number: 21-6585D | APPROVED: | REVISED:



Grid Sample Location1	Depth to Till Water (ft bgs)2	Depth to Top of Till (ft bgs)2	Sample Depth (saturated stratum)3
45	10	8.5	13
64	13	9.5	20
134	10	8.5	10
196	9.5	10.0	17
205	14.5	9.5	21
235	11	8.0	18
247	11	9.0	11
257	15	8.0	22
281	14.5	8.0	17
319	8	8.0	15
456	15.5	8.5	13
507	10	8.0	17
516	8	10.0	16
540	8	9.0	11

Notes:
1. Represent proposed soil boring locations
2. Feet bellow ground surface
3. Depth represents base of one-foot sample interval

KEY

- **Grid Point (Grid Interval = 10ft.)**
- **Randomly Selected Sampling Location**

25 12.5 0 25 50

SCALE: 1" = 25'

CPF\ECC\South Pad\Acad\Proposed Samp locations & Depths for Saturated Stratum

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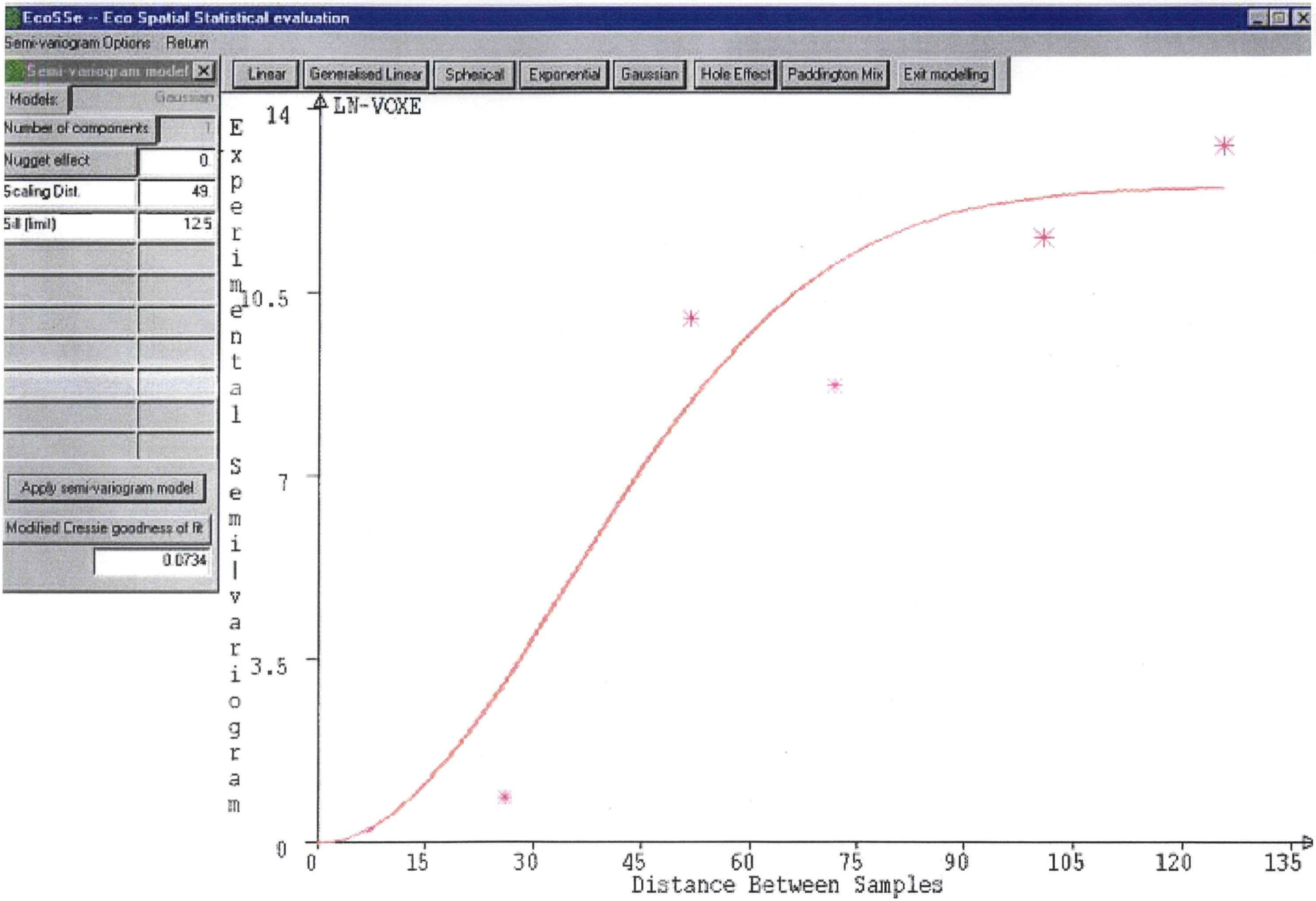
Proposed Sample Locations and Depths for Saturated Stratum
Southern Concrete Pad Area
ECC Site
Zionsville, IN

Figure 5

Drafter: APR | Date: 12/12/01 | Contract Number: 21-6585D | APPROVED: | REVISED:

APPENDIX A

Grid Spacing Semi-Variogram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Semi-variogram Options Return
Semi-variogram model
Models: Gaussian
Number of components 1
Nugget effect 0
Scaling Dist. 49
Sill (lml) 12.5
Apply semi-variogram model
Modified Cressie goodness of fit
0.0734
Linear
Generalised Linear
Spherical
Exponential
Gaussian
Hole Effect
Paddington Mix
Exit modelling
LN-VOXE
Experimental Semivariogram
14
10.5
7
3.5
0
0
15
30
45
60
75
90
105
120
135
Distance Between Samples